

## INTRODUCTION TO MANUFACTURING

**Introduction to Manufacturing** is a course that specializes in how people use modern manufacturing systems with an introduction to manufacturing technology and its relationship to society, individuals, and the environment. An understanding of manufacturing provides a background toward developing engineering & technological literacy. This understanding is developed through the study of the two major technologies, material processing and management technology, used by all manufacturing enterprises. Students will apply the skills and knowledge of using modern manufacturing processes to obtain resources and change them into industrial materials, industrial products, and consumer products. Students will investigate the properties of engineered materials such as: metallics; polymers; ceramics; and composites. After gaining a working knowledge of these materials, students will study six major types of material processes: casting and molding; forming; separating; conditioning; finishing; and assembling.

- DOE Code: 4784
- Recommended Grade Level: Grade 9-12
- Recommended Prerequisites:
- Credits: 1 credit per semester, 2 semesters maximum, maximum of 2 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas

### Application of Content

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences.

## Content Standards

### Domain 1 – Manufacturing: History and Relevance

**Core Standard 1** Students analyze the evolution of manufacturing to determine the effect it has had and will have on society.

#### Standards

- ITM-1.1 Describe the history and relevance of manufacturing
- ITM-1.2 Students will explain the societal impact of manufacturing
- ITM-1.3 Describe the impact manufacturing has had on the environment, the economy, and society
- ITM-1.4 Identify and describe the development of the manufacturing enterprise

### Domain 2 – Product Design

**Core Standard 2** Students adapt and apply knowledge and skills of the product design process to develop products.

#### Standards

- ITM-2.1 Utilize the basics of product design
- ITM-2.2 Explain the concepts of engineering and its importance within manufacturing
- ITM-2.3 Relate the systems, components, and processes of a technological system to

manufactured products

ITM-2.4 Communicate the lifecycle of a product

ITM-2.5 Demonstrate the design process for developing a product for production

ITM-2.6 Differentiate between different manufacturing systems

### **Domain 3 – Product Manufacturing**

**Core Standard 3** Evaluate manufacturing processes to determine how a product is or will be made.

#### **Standards**

ITM-3.1 Differentiate between the various types of materials and their applications

ITM-3.2 Determine the appropriate product processes and equipment used to create a product

ITM-3.3 Explain and identify the significance of quality control within product manufacturing

ITM-3.4 Examine the steps and process of product assembly

ITM-3.5 Investigate the different types of manufacturing processes

ITM-3.6 Differentiate between the different tools of manufacturing and the different tools used in production

ITM-3.7 Discuss the impact of manufacturing processes on the environment

ITM-3.8 Describe the procedures used in selecting and sequencing operations

ITM-3.9 Define and describe destructive and nondestructive testing

ITM-3.10 Examine quality control and quality assurance as an important part of the entire manufacturing company

### **Domain 4 – Safety**

**Core Standard 4** Students assess the impact of safety practices in a manufacturing environment.

#### **Standards**

ITM-4.1 Identify hazards and apply safety methods for working in manufacturing jobs

ITM-4.2 Recognize the importance of safety, products, and people

ITM-4.3 Recognize and properly use safety equipment

ITM-4.4 Communicate prevention strategies in a workplace or lab to make it safer by reducing the possibility of injuries and illnesses

ITM-4.5 Operate equipment and tools using the appropriate safety rules

ITM-4.6 Demonstrate proper maintenance and storage of equipment and tools

ITM-4.7 Choose the right equipment or tool for the project/job

ITM-4.8 Identify the use and safe operation of tools used in manufacturing

### **Domain 5 – Materials and Resources**

**Core Standard 5** Students analyze manufacturing materials and resources used to produce products for consumer safety, production, durability, and usability.

#### **Standards**

ITM-5.1 Identify and describe the resources associated with manufacturing

ITM-5.2 Explain how production is affected by of the availability, quality and quantity of resources

ITM-5.3 Demonstrate managing of resources

ITM-5.4 Research ways materials can be changed to meet product requirements

- ITM-5.5 Identify and explain the properties and characteristics of engineering materials
- ITM-5.6 Differentiate among a raw material standard stock and finished products
- ITM-5.7 Explain relationships between function, materials characteristics and properties, material selection and material processing
- ITM-5.8 Formulate an understanding of material handling and its significance

### **Domain 6 – Technical Drawing**

**Core Standard 6** Students incorporate technical drawing and sketching to produce a product.

#### **Standards**

- ITM-6.1 Identify and describe how precision and consistency are essential to the process of manufacturing
- ITM-6.2 Interpret basic drawings and symbols of technical sketching
- ITM-6.3 Create prototypes in solid modeling software
- ITM-6.4 Identify, develop, and communicate the specifications for a product

### **Domain 7 – Manufacturing Careers**

**Core Standard 7** Students evaluate the education, training, and certification needed for careers in manufacturing.

#### **Standards**

- ITM-7.1 Communicate employment and career opportunities in manufacturing
- ITM-7.2 Identify and describe variety of skill levels and educational requirements involved for careers in manufacturing
- ITM-7.3 Examine major work activities, average income, educational requirements, and helpful courses for the careers related to manufacturing

### **Domain 8 – Automation**

**Core Standard 8** Students will adapt and apply the safe use of automation in manufacturing systems with emphasis on the role of robotics in the process.

#### **Standards**

- ITM-8.1 Define and describe automation systems
- ITM-8.2 Program and use automated and robotic systems
- ITM-8.3 Identify reasons for implementing automation
- ITM-8.4 Identify the impact of automation in individuals, society and the environment
- ITM-8.5 Create a manufacturing cell for use
- ITM-8.6 Describe the history and relevance of logistics

## **Process Standards**

### **Common Core Literacy Standards for Technical Subjects**

#### **Reading Standards for Literacy in Technical Subjects 9-10**

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

#### **Key Ideas and Details**

- 9-10.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to the

precise details of explanations or descriptions.

- 9-10.RT.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- 9-10.RT.3 Follow precisely a complex multistep procedure when performing technical tasks, attending to special cases or exceptions defined in the text.

#### **Craft and Structure**

- 9-10.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 9-10 texts and topics*.
- 9-10.RT.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
- 9-10.RT.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

#### **Integration of Knowledge and Idea**

- 9-10.RT.7 Translate technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
- 9-10.RT.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a technical problem.
- 9-10.RT.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

#### **Range of Reading and Level of Text Complexity**

- 9-10.RT.10 By the end of grade 10, read and comprehend technical texts in the grades 9-10 text complexity band independently and proficiently

#### **Writing Standards for Literacy in Technical Subjects 9-10**

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

#### **Text Types and Purposes**

- 9-10.WT.1 Write arguments focused on *discipline-specific content*.
- 9-10.WT.2 Write informative/explanatory texts, including technical processes.
- 9-10.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

#### **Production and Distribution of Writing**

- 9-10.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

- 9-10.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- 9-10.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

#### **Research to Build and Present Knowledge**

- 9-10.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- 9-10.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation
- 9-10.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

#### **Range of Writing**

- 9-10.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

#### **Career and Technical Student Organizations**

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in a Career and Technical Student Organization, such as **Business Professional of America, DECA, or Future Business Leaders of America.**